



## Engineering Sciences Section – 2003

### C19 Techniques of Analysis of a Log Truck/Pick-Up Collision

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The goal of this presentation is to describe the unique steering characteristics of log trucks and a practical means of demonstrating braking performance of vehicles in tow.

On July 8, 1999, on U.S. Highway 101, near Humptulips, WA, a northbound pick-up truck towing a recreational trailer emerging from about a three degree right curve collided with the loaded trailer of a "long" log truck which had entered the highway from the east and was turning south. A passenger in the pick-up brought suit naming, among others, the state, alleging improper signage and failure to cut roadside vegetation so as to maintain visibility.

More than a year after the accident, position of the log trailer wheels and the pick-up truck at impact were determined by a combination of the record of tire marks and other scene artifacts and the impact-caused deformation of the pick-up. Next, the path of the log truck and its trailer were developed to determine the distance the log truck traveled after it started forward from its stop before entering the highway. The paths of the wheels of the truck/tractor's front (steered) wheels and its tandem dual drive wheels were relatively straightforward. However, the log bunks on the truck/tractor were forward of the "bogey" of the driving axles and the "stinger," or coupling, of the trailer "reach" was well aft of the driving axles.

On a long-log trailer, the trailer is actually towed by the logs and all acceleration and deceleration forces are transmitted by friction between the logs and the front and rear bunks assisted by whatever binders are used. Both bunks pivot on their supports and the "reach," a long tubular steel section, is free to slide within a sleeve in the trailer frame. Thus, when the tractor starts a left turn, the logs connect the bunks at a constant distance, but the reach coupling would be to the left of the log centerline so that the reach would slide forward within the trailer sleeve and turn the trailer to the right with respect to the log centerline. This action has the effect of significantly reducing the off tracking of the trailer and enables the log truck to negotiate the mountain roads of the northwest forests.

Monitoring acceleration rates of similarly loaded log trucks at the site gave a reasonable approximation of the acceleration of the log truck entering the highway. Then an iterative process varying the time rate of steering and plotting the paths of the truck/tractor and trailer was performed until the path of the tractor stayed within the limits of the roadway and the trailer passed over its position at impact. The time intervals were then calculated from the log truck's start at the stop line to its position at impact and various intermediate positions.

Photographs taken at the time of the accident compared with measurements at the scene during the investigation gave a basis for determining the probable sight lines at the time of the accident.

Examination of the recreational trailer being towed by the pick-up truck revealed that the electrical system of the brakes functioned properly but the brake drums were worn. The brakes were also out of adjustment, and three of the four drums were contaminated with grease.

Another expert was reported to have towed the R.V. trailer with a similar pick-up and had determined that, when the brakes were applied, a deceleration of 0.4 g's was measured using a G-analyst.

Analysis of the accident indicated that, at impact, the speed of the log truck was 15 to 17 mph and the speed of the pick-up was 27 to 33 mph after leaving 246 feet of skid marks from the pick-up. Using the measured braking capability of the pick-up and trailer combination, an initial speed of 61 to 64 mph was calculated. The speed limit was 60 mph, but a speed advisory plate for the intersection indicated 40 mph.

There was dispute about the sight distance available at the accident scene because of roadside vegetation. However, using the accident photos, the nearest position at which the approaching pick-up driver could have seen the log truck in the intersection was determined. An actual run of a similar vehicle being decelerated at 0.4 g's demonstrated that from a speed of 60 mph, the pick-up truck could have been stopped in time to avoid the accident. Using the opposing expert's measurements avoided the argument about drag factors.

It was further shown that the pick-up driver could have avoided the collision by simply steering to the right in his lane, rather than jamming on the brakes and skidding the pick-up to straddle the line and impact the log trailer. It was also found that the positioning of the warning signs conformed to the state standards.

Recognition of the major contribution to the cause of the accident by the pickup driver facilitated a settlement of the case.

#### Log Trailer, Pick-Up, Braking